



9th Workshop on Russian-German Cooperation: Laptev Sea System

10th Anniversary of the Otto Schmidt Laboratory: Scientific Symposium



November 23-27, 2009
Saint-Petersburg, Russia



9th Workshop on Russian-German Cooperation: Laptev Sea System

PROGRAM

November 23, 2009

Throughout the day	Arrival of participants
19:00	Icebreaker and registration (Hotel Park Inn Pribaltiskaya)

November 24, 2009

09:30-10:00	Registration (AARI, Small Hall, 1 st floor)
10:00-10:30	9 th Workshop on Russian-German Cooperation: Laptev Sea System – Opening words - Alexander I. Danilov, Vice Director AARI - Leonid A. Timokhov, AARI - Heidemarie Kassens, IFM-GEOMAR
10:30-13:00	Session I: Ocean-Sea Ice-Atmosphere observations in and around the Laptev Sea polynya including Poster Session
13:00-14:30	Lunch
14:30-17:00	Session II: Biological, geochemical and sedimentological importance of frontal zones and polynyas in the Laptev Sea including Poster Session including Poster Session
17:00-17:30	Posters & Coffee
	Dinner in town



November 25, 2008

09:30-12:00	Session III: Remote sensing and modelling of polynya formation processes and ice production including Poster Session
12:00-13:00	Lunch Break
13:00-15:00	Session IV: Resume and outlook
16:00	Scientific symposium of the OSL (AARI, Middle Hall)

Session I: Ocean-Sea Ice-Atmosphere Observations in and Around the Laptev Sea Polynya

Chairpersons: Hoelemann, J.A. & Kirillov, S.

Overview lecture: Hoelemann, J.A.

Talks

- Klagge, T.: TRANSDRIFT XII - XVI: Technical implementations and new approaches for measuring and retrieving data
- Dmitrenko, I., S.A. Kirillov, T. Klagge, L.B. Tremblay, D. Bauch, J.A. Hoelemann, T. Krumpen, H. Kassens, C. Wegner, G. Heinemann, D. Schroeder: The Arctic Ocean Atlantic water layer impacts the Siberian shelf hydrography
- Kirillov, S.A., I.A. Dmitrenko, M.S. Makhotin, J.A. Hoelemann, E.V. Bloshkina: The Laptev Sea bottom layer hydrography: 2007-2009 seasonality and impacting factors
- Rabenstein, L.: Helicopter Electro Magnetic sea-ice thickness surveying during TRANSDRIFT XIII

Posters

- Bloshkina, E.V., L.A. Timokhov: Calculation of turbulent characteristics under drifting ice on the basis of currents velocity data
- Heinemann, G., D. Schroeder, A. Helbig, D. Kramer: Atmospheric conditions during TRANSDRIFT 2008/09 and comparison to climatology
- Helbig, A., G. Heinemann, S. Adams, T. Ernsdorf: Meteorological observations during Laptev Sea winter experiments 2008 and 2009
- Makhotin, M., L.A. Timokhov: Variability of Pacific origin water in the Arctic Ocean
- Radermacher, C., G. Heinemann: Tracking of synoptic weather systems in the Siberian Arctic and their impact on the Laptev Sea polynya
- Ryzhov, I.: Long-term changes of extreme levels of Arctic seas and their reasons
- Sergienko, I.: Recent thermohaline changes of the frontal zones in the Laptev Sea: results of TRANSDRIFT XII (BARKALAV-2007) and XIV (BARKALAV-2008)
- Willmes, S., T. Krumpen, S. Adams, L. Rabenstein, C. Haas, J.A. Hoelemann, S. Hendricks, G. Heinemann: Cross-Validation of polynya monitoring methods from multi-sensor satellite and airborne data: a case study for the Laptev Sea

Session II: Biological, Geochemical and Sedimentological Importance of Frontal Zones and Polynyas in the Laptev Sea

Chairpersons: Wegner, C. & Novikhin, A.

Overview lecture: Wegner, C.

Talks

- Bauch, D., E. Dobrotina, M. Groeger, J.A. Hoelemann, T. Klagge, F. Martynov, A. Nikulina, A. Novikhin, R. Spielhagen: Imprint of sea-ice formation on Laptev Sea water masses
- Novikhin, A. , F. Martynov, E. Abramova, J.A. Hoelemann, D. Bauch: Nutrients and Chlorophyll distribution in the Laptev Sea frontal zones according to 2007-2009 summer data
- Polyakova, Ye.I., T.S. Klyuvitkina, L. Astakhova: Spring sea-ice algal and ice-edge phytoplankton communities from the Laptev Sea polynya in April 2008
- Abramova, E., F. Martynov, D. Taborskiy, A. Abramova: Spatial and temporal variability in zooplankton species composition and distribution in the Laptev Sea polynya in 2007-2008

Posters

- Abramova E., A.A. Chetverova, G. Soloviev, A. Abramova: First records of three *Eurytemora* species (Copepoda, Calanoida) in the Lena Delta in summer 2006-2008: taxonomy, distribution and ecology
- Charkin, A.N., A.A. Chetverova , I.V. Fedorova, O.V. Dudarev, I.P. Semiletov: Suspended and bottom sediment transformation in central and coastal zones of the Lena River delta
- Groeger, M., D. Bauch, R. Spielhagen: Lena freshwater export during Arctic summer
- Kulakov, M., C. Wegner: Modelling of suspended sediment dynamics in the Laptev and East-Siberian seas
- Makshtas, A. , A. Smirnov, R. Vlasenkov: Radiation characteristics, CDOM, and suspended matter in the Kara and Laptev seas
- Martynov, F., E. Abramova, A. Novikhin, J.A. Hoelemann: Chlorophyll a patterns in the Laptev Sea in September 2007
- Soloviev, G., F. Martynov, D. Taborskiy, E. Abramova: Preliminary results of macrobenthic organism distribution in the Laptev Sea polynya in winter 2009

Session III: Remote Sensing and Modelling of Polynya Formation Processes and Ice Production

Chairpersons: Heinemann, G. & Makshtas, A.

Overview lecture: Heinemann, G.

Talks

- Willmes, S., S. Adams, D. Schroeder, G. Heinemann: Spatiotemporal variability of sea-ice coverage, polynya dynamics and ice production in the Laptev Sea between 1979 and 2008
- Krumpen, T., J.A. Hoelemann, T. Busche, I. Dmitrenko, C. Haas, S. Hendricks, R. Gerdes, S. Kirillov, T. Klagge, L. Rabenstein, M.A. Morales Maqueda, P. Rozman, D. Schroeder, S. Willmes: Observation and modelling of the West New Siberian Polynya during two seasonal cycles
- Rozman, P., R. Gerdes, C. Koeberle: Role of the fast ice in an Arctic sea ice-ocean-coupled model
- Schroeder, D., G. Heinemann, L. Ebner, T. Ernsdorf, S. Adams, S. Willmes, R. Timmermann: Polynya studies in the Laptev Sea with a fully coupled high resolution atmosphere-sea ice-ocean model

Posters

- Adams, S., T. Krumpen, S. Willmes, J.A. Hoelemann, A. Helbig: The contribution of aerial survey during TRANSDRIFT XV to the investigation of the thin ice thickness distribution
- Adams, S., S. Willmes, G. Heinemann, P. Rozman, R. Timmermann, D. Schroeder: Validation of simulated sea-ice concentrations from sea-ice/ocean models using satellite data
- Alexeeva, T.: Ice conditions of navigation along the perspective routes in the southeastern Barents Sea
- Bogorodskiy, P., A. Pnyushkov, M. Makhotin: Forming and evolution of lead ice
- Chernyavskaya, E.: Changes of surface layer TS-structure in the Arctic Ocean in 2007-2008 summer period
- Chernyavskaya, E., Timokhov, L.: Arctic Ocean surface layer salinity decomposition on empirical orthogonal functions

- Ebner, L., D. Schroeder, G. Heinemann: Impact of Laptev Sea flaw polynyas on the atmospheric boundary layer and ice production using idealized mesoscale simulations
- Ernsdorf, T., G. Heinemann, D. Schroeder, S. Adams, A. Helbig, R. Timmermann, S. Willmes: Simulation of Laptev Sea polynya dynamics using the FESOM model with different atmospheric forcings
- Schroeder, D., G. Heinemann, S. Willmes: Implementation of a thermodynamic sea ice module in the NWP model COSMO and its impact on simulations for the Laptev Sea area in the Siberian Arctic
- Timofeeva, A.: Seasonal and multi-year variability of sea ice in the Laptev Sea

Session IV: Resume and Outlook

Chairpersons: Kassens, H. & Timokhov, L.

Overview lecture: Kassens, H.

Talks

- Timokhov, L., H. Kassens, D. Bolshiyarov, J.A. Hoelemann, I. Dmitrenko, S. Kirillov, A. Novikhin: Laptev Sea System response to the Arctic climate extreme events
- Spielhagen, R.F., I. Dmitrenko: Recent Laptev Sea warming in context of oceanic heat advection to the Arctic in the last 2000 years
- Bauch, H.A., H. Kassens, Ye. Polyakova, E. Taldenkova, G. Cherkashov, V. Spiess: Arctic shelf drilling for paleoclimate archives
- Grigoriev, M.N.: Coastal and subsea permafrost studies in the Siberian shelf-coastal zone: results and outlook
- Gottschalk, J., E. Taldenkova: Environmental history of the western Laptev Sea since the Late Pleistocene
- Hubberten, H.-W., D. Bolshiyarov, J. Boike, P. Overduin, D. Wagner: Carbon cycling in permafrost – past, present and future
- Dullo, W.-C., R. Tiedemann, D. Nuernberg, J.-R. Riethdorf, L. Max: Reconstruction of Late Pleistocene-Holocene climate and oceanography in the subarctic NW Pacific



Scientific Symposium of the OSL Fellowship Program and 10th Anniversary of the OSL, starting at 16:00 at the AARI/OSL

PROGRAM

November 25, 2009

16:00	Scientific Symposium of the OSL Fellowship Program (AARI, Middle Hall)
S. Kirillov:	Historical minimum in the arctic sea-ice extent in September 2007
D. Martynova:	Arctic copepods in a changing sub-Arctic sea: is species success possible?
O. Semenova:	Runoff modelling in Arctic basins – River Lena
E. Bazhenova:	Late Quaternary environments in the Arctic based on deep-ocean sediments
A. Portnov:	Research of gas in sediments of the Kara Sea
A. Pavlov:	Association of Polar Early Career Scientists
17:00	Posters & Wine & Zakuski (AARI, Middle Hall)
18:00	10th Anniversary of the Otto Schmidt Laboratory (AARI, Middle Hall)

Prof. Dr. I. Frolov (AARI)
Prof. Dr. K. Lochte (AWI)
MR R. Ollig (BMBF)
Dr. A.S. Studenetsky (Minobrnauki)
Botschaftsrat K. Heinz (German Embassy Moscow)
Prof. Dr. N. Kaledin (St. Petersburg State University)
Academician A.P. Lisitsyn (P.P. Shirshov Institute of Oceanology RAS)
Prof. Dr. J. Thiede (University of Copenhagen)
U. Doering (Former Minister for Labor, Justice and European Affairs; TRANSDRIFT XV participant)
Prof. Dr. L. Timokhov (AARI)

FIRST RECORDS OF THREE *EURYTEMORA* SPECIES (COPEPODA, CALANOIDA) IN THE LENA DELTA IN SUMMER 2006-2008: TAXONOMY, DISTRIBUTION AND ECOLOGY

E. Abramova¹, I. Vishnyakova², A. Chetverova², G. Soloviev³, A. Abramova²

¹Lena-Delta State Nature Reserve, Tiksi, Russia

²St. Petersburg State University, St. Petersburg, Russia

³St. Petersburg State Polytechnical University, St. Petersburg, Russia

Three rare calanoida copepod crustaceans of *Eurytemora* genus: *Eurytemora gracilicauda* Akatova, 1949, *Eurytemora arctica* Wilson and Tash, 1966 and *Eurytemora foveola* Johnson, 1961 were collected from the lakes on Samoylov Island of the Lena River Delta, Eastern Siberia, Russia. This is the first record of two last species in Eurasia. Previously it was found only in Alaska. We hypothesize that the specimens of *Eurytemora* may have been passively transported with Lena river waters, or by shorebirds migrations or there distribution is connected with last glaciations strongly affected on crustaceans biogeography in circumpolar regions.

SPATIAL AND TEMPORAL VARIABILITY IN ZOOPLANKTON SPECIES COMPOSITION AND DISTRIBUTION IN THE LAPTEV SEA POLYNYA IN 2007-2009

E. Abramova¹, F. Martynov², D. Taborskiy³, A. Abramova³

¹Lena-Delta State Nature Reserve, Tiksi, Russia

²Arctic and Antarctic Research Institute, St. Petersburg, Russia

³St. Petersburg State University, St. Petersburg, Russia

The distribution pattern and seasonal-interannual variability of zooplankton species composition and abundance in dependence to primary production, hydrological, hydrochemical and ice conditions are analyzed for the Laptev Sea Polynya region.

Zooplankton was found to be represented by 20 taxa in winter and 35 taxa in summer. According to the average multiannual data (1996-2004) zooplankton in the study area was dominated by *Oithona similis* - *Pseudocalanus* sp. - *Drepanopus bungei* assemblage. *O. similis* is a cosmopolitic marine euryhaline species, two others are euryhaline brackishwater species. These three species formed the bulk of pelagic fauna in Polynya region (up to 80% of the total zooplankton number). In summer 2007, and especially in winter 2008, the dramatic changes in the percentage of dominant species were observed. During these expeditions only rare exemplars of *Pseudocalanus* sp. and *D. bungei* were found at several stations. The relative abundance of *Oithona similis* and *Microcalanus pygmaeus* sharply increased. For the whole region on average, 20% of pelagic organisms consist of *O. similis* and 7,5% of *M. pygmaeus*. These species are typical representatives of the Laptev Sea continental slope association. Thus, the observed changes could be related to the growing influence of open-sea waters on the inner shelf regions.

THE CONTRIBUTION OF AERIAL SURVEY DURING TRANSDRIFT XV TO THE INVESTIGATION OF THIN ICE THICKNESS DISTRIBUTION

S. Adams¹, T. Krumpfen², S. Willmes¹, J.A. Hoelemann², A. Helbig¹, S. Kirillov³

¹Trier University, Fac. of Geography/Geosciences, Environmental Meteorology, Trier, Germany

²Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

³Arctic and Antarctic Research Institute, St. Petersburg, Russia

A considerable fraction of the sea-ice production on Arctic shelf areas is estimated to take place in the Laptev Sea polynyas. For the quantification of the sea-ice budget by means of remote sensing data the investigation of the thin ice thickness distribution and development within the polynya is essential. Thus, the monitoring of sea-ice has to be improved with respect to the spatial resolution. We present an innovative airborne data set of surface temperatures with very high spatial resolution and simultaneously detected aerial photographs performed during TRANSDRIFT XV. The ice surface temperatures will be used to derive thin ice thickness profiles following a modified thermal ice thickness algorithm and validate the existing methods. The aerial photographs give an overview of the general ice conditions.

VALIDATION OF SIMULATED SEA-ICE CONCENTRATIONS FROM SEA-ICE/OCEAN MODELS USING SATELLITE DATA

S. Adams¹, S. Willmes¹, G. Heinemann¹, P. Rozman², R. Timmermann¹, D. Schroeder¹

¹Trier University, Fac. of Geography/Geosciences, Environmental Meteorology, Trier, Germany

²Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

Sea-ice concentrations in the Laptev Sea simulated by the coupled North Atlantic – Arctic Ocean – Sea-Ice Model (NAOSIM) and Finite Element Sea-Ice Ocean Model (FESOM) are validated using sea-ice concentrations from AMSR-E satellite data and a polynya classification method for winter 2007/08. Simulated sea-ice fields from different model runs are compared with emphasis on the impact of an integrated fast-ice mask. Sea-ice models are not able to simulate polynyas realistically when used in their operational versions. Without fast ice, our investigations indicate that the simulation of large leads and smoothed sea-ice concentration fields compensates the absence of the polynyas. After implementation of a fast-ice mask the polynya location is realistically simulated, but the total open water area is largely overestimated. The study shows that further model improvements are necessary in order to achieve the important step from the simulation of large-scale features in the Arctic towards a more detailed simulation of smaller-scaled features (here polynyas) in an Arctic shelf sea.

ICE CONDITIONS OF NAVIGATION ALONG THE PERSPECTIVE ROUTES IN THE SOUTHEASTERN BARENTS SEA

T. Alexeeva

Arctic and Antarctic Research Institute, St. Petersburg, Russia

The Arctic shelf contains unique hydrocarbons resources, and their development is very intensive in present time. One of the key questions is oil and gas transportation to the areas

of consumption. The most advanced and ecologically safe alternative is transportation by the seaway, but shipping is significantly prevented by difficult ice conditions: steady ice cover, characterized by strong seasonal and multi-year variability is forming annually in the southeastern Barents Sea. Weekly AARI sea ice maps, SSM/I satellite images and shipborne data were used to determine variability of sea ice conditions in the research area and on the perspective routes of navigation during the period 2003-2009. From the video record, obtained onboard tanker “Norilskiy Nikel” by newly developed TV-complex, correlation between sea ice thickness and ship’s velocity was obtained. This allowed to estimate time periods when navigation of different vessels types is safety and possible with and without icebreakers.

DEVELOPMENT OF THE INFORMATION SYSTEM ON THE IMPACTS OF CHANGING PERMAFROST ON THE INFRASTRUCTURE

O. Anisimov, J. Strelchenko, V. Kokorev

State Hydrological Institute, St. Petersburg, Russia

Changes in the temperature, distribution, and depth of seasonal thawing of permafrost will have implications for the infrastructure built upon it. Permafrost model forced with climatic projections was used to calculate a “settlement” index and to construct probabilistic geocryological hazard maps characterizing potential for thermokarst development and threats to infrastructure.

IMPRINT OF SEA-ICE FORMATION ON LAPTEV SEA WATER MASSES

D. Bauch^{1,2}, E. Dobrotina³, M. Groeger⁴, J.A. Hoelemann⁵, T. Klagge¹, F. Martynov³, A. Nikulina¹, A. Novikhin³, R. Spielhagen²

¹Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

²Mainz Academy of Sciences, Humanities and Literature, Mainz, Germany

³Arctic and Antarctic Research Institute, St. Petersburg, Russia

⁴Max Planck Institute for Meteorology, Hamburg, Germany

⁵Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

The distribution of river water and brines enriched waters on the Laptev Sea shelf can be derived based on salinity and $\delta^{18}\text{O}$ values. While in 1994 maximal influence of brines is seen within bottom waters, the influence of brines in 2007 is highest within the surface layer and only a moderate influence of brines is detected in bottom waters. This inverted distribution of brines in the water column in 2007 suggests a less effective winter sea-ice formation combined with advection of more saline waters from the outer shelf in the winter precedent to the climatically extreme summer 2007. Salinity and $\delta^{18}\text{O}$ data from summer 1994 clearly identifies a locally formed brine enriched bottom water mass as mixing agent between surface layer and inner shelf waters on one side as well as water from the outer Laptev Sea on the other side. This brine enriched bottom water is missing in 2007 and replaced by a saltier water body, in which a reduced influence of river water and brines is detected.

First results from April 2008 salinity and $\delta^{18}\text{O}$ data demonstrates, that brine enriched bottom water is formed within the polynya. In addition the data show that also during winter lateral advection processes are of significant influence as seen in two predominant mixing lines in the salinity / $\delta^{18}\text{O}$ correlation.

ARCTIC SHELF DRILLING FOR PALEOCLIMATE ARCHIVES

H.A. Bauch¹, H. Kassens², Ye. Polyakova³, E. Taldenkova³, G. Cherkashov⁴, V. Spiess⁵

¹Mainz Academy of Sciences, Humanities and Literature, Mainz, Germany

²Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

³Moscow State University, Moscow, Russia

⁴VNIIOkeangeologia, St. Petersburg, Russia

⁵Bremen University, Bremen, Germany

Over the past 15 years, Russian and German scientists have systematically investigated the paleoenvironmental system of the Laptev Sea to decipher the mechanisms that control environmental change in the Siberian Arctic during the Holocene. Numerous sediment cores with a maximum length of up to 9 m were taken from this region during several ship-based expeditions. A major step forward to study Arctic climate change on time scales beyond the Holocene was the expedition TRANSDRIFT VIII using the Russian drilling vessel KIMBERLIT in the year 2000. The drill shipboard party cored several holes at two sites in the northeastern Laptev Sea. During that short leg (only five days), a total length of 40 m of sediments were recovered. The sediments show that subsea permafrost persists at the drill sites some 15 to 20 m below the sea floor, and covered up by an unfrozen sediment package of Holocene age.

Based on the pilot phase in 2000 it is now planned to resume drilling in the Laptev Sea. The proposed drill sites are in the seasonally ice-covered part of the shallow shelf east of the Lena Delta. This area is logistically more easily accessible, and moreover, a detailed site surveys has already been carried out in 2004. The primary goal of this new drilling campaign is to recover long sediment cores (up to 120 m below sea floor) in order to study Arctic climate change over a number of Pleistocene climatic cycles. These studies will include the following specific objectives:

- centennial to millennial-scale paleoclimate changes during past glacial/interglacial cycles,
- long-term history of ice-sheets and permafrost, land/ocean-sediment flux, river discharge, and Arctic biota,
- sea-level change and its effects on Arctic shelf environments,
- sources and sinks of greenhouse gases,
- long-term stability and variability of subsea permafrost.

LATE QUATERNARY ENVIRONMENTS IN THE ARCTIC BASED ON DEEP-OCEAN SEDIMENTS

E. Bazhenova

Master Program for Applied Polar and Marine Sciences POMOR, St. Petersburg State University, St. Petersburg, Russia

This study is focused on sediment cores recovered from southern Mendeleev Ridge during the ARK-XXIII/3 (Arctic-2008) Expedition of RV 'Polarstern'. We use various sedimentary proxies such as lithology (sediment colour and ice-rafted debris contents), physical properties (density, magnetic susceptibility, p-wave velocity, shear strength measurements), mineralogy (bulk mineralogical composition), geochemistry (total organic carbon contents, C/N ratio) and biostratigraphy (distribution of planktonic and benthic foraminifers) to reconstruct paleoceanographical conditions in the Siberian part of the Amerasian Basin during late Quaternary times. The preliminary age model is based on correlation to the stratigraphy developed for the Mendeleev Ridge. For correlation we mainly used lithology

(color cycles, IRD contents), bulk density and detrital carbonate (dolomite) contents as well as distribution of forams. The obtained proxy records demonstrate that sedimentary environments at the East Siberian Sea continental margin were strongly variable during late Quaternary times. Using sedimentation patterns we suggest that there were three major scenarios for transportation and deposition of terrigenous material derived from the adjacent shelves, generally controlled by extension of sea-ice cover and iceberg discharge.

CALCULATION OF TURBULENT CHARACTERISTICS UNDER DRIFTING ICE ON THE BASIS OF CURRENTS VELOCITY DATA

E.V. Bloshkina, L.A. Timokhov

Arctic and Antarctic Research Institute, St. Petersburg, Russia

Our study is focused on numerical modeling and obtaining the general turbulence characteristics by inverse method on the base of averaged currents velocity data and one-dimensional model of turbulence.

The ocean turbulence description is an important problem of modern physical oceanography due to its key role in ocean processes. The turbulent regime under drifting ice forms vertical fluxes of impulse, heat and mass that greatly affect ocean – ice – air interaction. At the moment the direct turbulent fluxes measurements under the drifting ice are limited. Therefore the more reliable possibility turbulent fluxes estimations are models.

In our work we apply k-L turbulence model. The vertical profiles of turbulence characteristics for different stratification are obtained. On the basis of calculated profiles we can conclude that using one-dimensional turbulence model coincides well with the results of inverse method. But some problems in vertical distribution of turbulent energy and turbulent scales are still exist. It can be explained that we use averaged profiles of currents velocity which are not measured simultaneously with density profiles. Thus we can use one – dimensional model for the further vertical fluxes estimation.

FORMING AND EVOLUTION OF LEAD ICE

P.V. Bogorodskiy¹, A.V. Pnyushkov^{1,2}, M.S. Makhotin¹

¹Arctic and Antarctic Research Institute, St. Petersburg, Russia

²International Arctic Research Center, University of Alaska, Fairbanks, USA

The detailed investigation of sea ice was performed using a conceptual thermodynamic model. The model is based on the heat and mass transfer equations and boundary conditions imposed at the upper and lower unknown moving interfaces of mushy (skeletal) zone, transforming at the top into solid ice, and takes into account energy exchange at the air-ice surface.

As the atmospheric forcing the NCEP/NCAR reanalysis data of winter 2006-2007 for the Northeastern Taimyr area (77.5°N, 112.5°E) were used. The periods of rapid ice growth, conditioned by the polynya forming were taken on the bases of the exceeding by the wind field component perpendicular to ice edge of the calculated critical value (14 m/s).

The computations showed that the model results are close to the measured ones both in thickness and transitions to successive age stages. The calculations were carried out for the two scenarios, the running growth and the interruptible one which took into account formation of the open water in cold season. At the end of cooling the thickness difference for both

scenarios progressively increases up to 1.5 m. The accumulative value of sea ice thickness for the second scenario is almost 2 times greater than for the first one.

SUSPENDED AND BOTTOM SEDIMENT TRANSFORMATION IN CENTRAL AND COASTAL ZONES OF THE LENA RIVER DELTA

A.N. Charkin¹, A.A. Chetverova², I.V. Fedorova³, O.V. Dudarev¹, I.P. Semiletov^{1,4}

¹V.I. Il'ichev Pacific Oceanological Institute FEB RAS, Vladivostok, Russia

²St. Petersburg State University, St. Petersburg, Russia

³Arctic and Antarctic Research Institute, St. Petersburg, Russia

⁴International Arctic Research Center, University of Alaska Fairbanks, USA

The Lena River has not so high turbidity but the biggest delta in the Russian Arctic. There are different opinions of the delta origin and future. Some studies show intensive sedimentation in the coastal zone, others on the contrary in the central or edge part of the delta.

Suspended material parameters are one of the main factors of determining the volume of terrigenous material alteration to the river-sea system, because they are extremely sensitive to the specificity of provenance rocks, exogenous transformations, and anthropogenic effects during mobilization and transfer.

There are a lot of field data on water and suspended material discharges along the main channels of the Lena River delta (Trofimovskaya, Sardakhskaya, Olenekskaya, and Tumatskaya) and moreover we have data on suspended material distribution, grain size composition of bottom sediment and suspended material, particulate organic carbon (POC), CN stable isotopes in POC and sediment in the southeastern part of the Buor-Khaya Gulf (the Laptev Sea, namely, near Bykovskaya).

Total suspended material content, grain size composition of bottom sediment and suspended particulate material (SPM) have been measured. Transects and maps of the suspended material distribution are discussed on hydrometeorological conditions changing. Comparing the SPM content in the Lena River and adjacent part of the Laptev Sea two basic zones of sedimentation were allocated. In the first case it is the middle course (region of 3-4 stations), lower course (region of 6-7 stations) and the head of delta because spreading of the river stream over numerous branches and channels was accompanied by a weakening of its transporting capacity and the decrease of SPM in the transfer system. In the second case the hydrodynamical sedimentational barrier in the delta-sea system it is the decrease of SPM in the water stream.

Received results will allow estimating the quantitative streams of SPM in the land-river-sea system. The multiyear runoff data are the basis for following hydro-morpho-dynamic forecast in the delta and adjacent part of the Laptev Sea.

CHANGES OF SURFACE LAYER TS-STRUCTURE IN THE ARCTIC OCEAN IN 2007-2008 SUMMER PERIOD

E. Chernyavskaya

Arctic and Antarctic Research Institute, St. Petersburg, Russia

The CTD-data obtained during expeditions ARCTICA-2007, NABOS-2007, BARKALAV-2007/TRANSDRIFT XII, ARCTICA-2008, BARKALAV-2008 in August-September of 2007

and 2008 and the ITP-buoy data were used as data source.

The estimations of surface layer characteristic, including mixed layer thickness, mixed layer mean temperature, mixed layer mean salinity and Brunt-Vaisala frequencies were calculated and spatial distribution maps were plotted. In analyzing the vertical profiles of temperature and salinity for upper 50-m layer three predominating profile types were distinguished and their spatial distribution in summer of 2007 and 2008 was mapped. The analysis of surface layer characteristics obtained shows that the main features of surface layer state in summer 2007-2008 were the extreme anomalies of temperature and salinity and big temperature and salinity contrast between Eurasian and Canadian basins. The dominating causes of anomaly forming in the Arctic Ocean surface layer were unique atmospheric circulation regime in spring and summer 2007 and anomalous atmospheric circulation regime in summer 2008.

ARCTIC OCEAN SURFACE LAYER SALINITY DECOMPOSITION ON EMPIRICAL ORTHOGONAL FUNCTIONS

E. Chernyavskaya, L. Timokhov

Arctic and Antarctic Research Institute, St. Petersburg, Russia

The Arctic Ocean water density is more depends on water salinity than on water temperature and the thermohaline circulation is mainly determined by salinity distribution which is influenced by the processes of ice formation, river runoff and precipitation. Method of decomposition on Empirical Orthogonal Functions (EOF) was used to study the interannual variability of the Arctic Ocean surface layer salinity. OF decomposition of the mean salinity in the surface layer of 50 m for the winter season 1950-1993 and 2007-2008 was carried out. The contribution of the three initial components in total dispersion of the original data is about 54% that is 28%, 16% and 10% for the first, the second and the third components, respectively. Spatial characteristics analysis of the 1-st, the 2-nd and the 3-rd modes of decomposition and their physical interpretation are considered. As a result, the salinity fields for each decomposition mode were mapped, phase portraits of the decomposition coefficients and graphs of their temporal variability were constructed, clusters with similar salinity characteristics were selected and typical salinity fields for each cluster were obtained.

RELATIONSHIP BETWEEN SEA-LEVEL PRESSURE EXTREME CHANGES AND ICE VARIABILITY IN THE LAPTEV SEA

D. Demchev

Arctic and Antarctic Research Institute, St. Petersburg, Russia

In our research we investigated extreme changes in SLP impacts on sea-ice variability in the Laptev Sea and west part of East-Siberian Sea from June to October over last 18 years. We investigated two opposite types of SLP extreme changes: 1st : Northern and Northern-Western wind direction changes on Southern and Southern-east. 2nd : Southern wind direction changes on Northern and Northern-Western. These types determined by analysis of synoptic maps from 1991 until 2009. Maps of ice variability created from ASI algorithm data with spatial resolution 12.5 x 12.5 (km) for the same period. The research shows relevance of further investigation of extreme changes in sea-level pressure fields and its impacts on sea-ice conditions in the Laptev Sea. Results of the research have practical relevance for model of 1-3 day sea-ice forecasts. The purpose of this model is to improve the safety of navigation in the Laptev Sea and particularly in Vilkitsky Strait.

THE ARCTIC OCEAN ATLANTIC WATER LAYER IMPACTS THE SIBERIAN SHELF HYDROGRAPHY

I.A. Dmitrenko¹, S.A. Kirillov², T. Klagge¹, L.B. Tremblay³, D. Bauch¹, J.A. Hoelemann⁴, T. Krumpen⁴, H. Kassens¹, C. Wegner¹, G. Heinemann⁵, D. Schroeder⁵

¹Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

²Arctic and Antarctic Research Institute, St. Petersburg, Russia

³McGill University, Montreal, Canada

⁴Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

⁵Trier University, Fac. of Geography/Geosciences, Environmental Meteorology, Trier, Germany

This paper examines the role of the Arctic Ocean Atlantic Water (AW) in modifying the Laptev Sea shelf bottom hydrography based on historical hydrographic records from 1932-2008, field observations carried out in April-May 2008, and 2002-2009 cross-slope measurements. A climatology of bottom hydrography demonstrates warming that extends offshore from the 30-50 m depth contour. Bottom layer temperature time series constructed from historical hydrographic records links the Laptev Sea outer shelf to the AW boundary current transporting warm and saline water from the North Atlantic downstream along the Eurasian continental margins. The AW warming of mid-1990s – mid-2000s is consistent with outer shelf bottom temperature variability. For April-May 2008 we revealed wind-driven on-shelf near-bottom warm and saline water intrusions up to the 20 m isobath. These intrusions are typically about 0.2 °C warmer and 1-1.5 psu saltier than ambient water. The 2002-2009 cross-slope observations are suggestive for the continental slope upward heat flux from the AW. With the AW layer as the only source of heat, the lateral on-shore wind-driven transport results in the bottom layer thermohaline anomalies recorded over the Laptev Sea shelf. We also found that polynya induced vertical mixing may act as a drainage of bottom layer permitting a relatively small portion of the AW heat to be directly released to the atmosphere. In addition, over the Laptev Sea shelf deeper than 10-15 m we revealed no significant transformations associated with climate change that may be critical for stability of relic offshore submarine permafrost.

RECONSTRUCTION OF LATE PLEISTOCENE-HOLOCENE CLIMATE AND OCEANOGRAPHY IN THE SUBARCTIC NW PACIFIC

W.-C. Dullo¹, R. Tiedemann², D. Nuernberg¹, J.-R. Riethdorf¹, L. Max²

¹Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

²Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

Study areas of the recent RV SONNE cruise 201 (Leg 2) include the eastern continental slope off Kamchatka Peninsula (500-2000 m) and the western Bering Sea (Komandorsky Basin, Shirshov Ridge). Sediment cores recovered are expected to present high-resolution records of the last ca. 60,000 years on seasonal to centennial timescales. Furthermore, hypotheses concerning the formation of intermediate water masses in the N Pacific, the glacial development of Kamchatka, and ocean-atmosphere teleconnections between the Atlantic and Pacific will be tested.

Previous studies in the adjacent Sea of Okhotsk suggest that environmental changes in both the Sea of Okhotsk area and in SE Asia were closely related via the Siberian atmospheric high-pressure cell. During full glacial times our records point to a strong Siberian High causing northerly wind directions, the extension of the sea ice cover, and a reduced Amur River discharge. Deglacial maxima of terrigenous flux were succeeded by or synchronous to high-productivity events. Marine productivity was strengthened during glacial terminations

because of an effective nutrient utilization at times of enhanced water column stratification and high nutrient supply from fluvial runoff and sea ice thawing. During interglacials, SE monsoonal winds prevailed, analogous to today's summer situation of a pronounced Mongolian Heat Low and a strong Hawaiian High. Strong freshwater discharge induced by high precipitation rates in the Amur drainage area and a seasonally reduced and mobile sea ice cover favored marine productivity (although being considerably lower than during the terminations) and a lowered flux of IRD.

A more detailed insight on centennial-scale changes in sea ice formation, fluvial sediment discharge and productivity during the Holocene comes from a high-resolution record from the continental margin off Sakhalin (LV28-4-4). The content and accumulation rates of biogenic opal served as a proxy of biogenic productivity whereas distributions of trace elements analyzed by XRF scanning were used as indicators of fluvial sediment discharge and IRD. For the Holocene, the K/Ti record strongly correlates with the Greenland GRIP oxygen isotope record. Moreover, this core indicates several short-term events (e.g. the 8.2 ky cooling event, the Medieval Warm Period and the Little Ice Age) similar to those found in the Atlantic realm.

IMPACT OF LAPTEV SEA FLAW POLYNYAS ON THE ATMOSPHERIC BOUNDARY LAYER AND ICE PRODUCTION USING IDEALIZED MESOSCALE SIMULATIONS

L. Ebner, D. Schroeder, G. Heinemann

Trier University, Fac. of Geography/Geosciences, Environmental Meteorology, Trier, Germany

The interaction between polynyas in the Laptev Sea and the atmospheric boundary layer is examined with the regional, nonhydrostatic atmosphere model COSMO. A thermodynamic sea ice model is used to consider the response of sea ice surface temperature to idealized atmospheric forcing. Cold wintertime conditions are investigated with sea ice-ocean temperature differences up to 40 K combined with different wind speed by varying wind direction. The Laptev Sea flaw polynyas strongly modify the ABL. Strong wind regimes lead to a more shallow mixed layer with strong near-surface modifications, while weaker wind regimes show a deeper well-mixed convective boundary layer. Shallow mesoscale circulations occur in the vicinity of ice-free and thin ice covered polynyas. They are forced by large surface energy fluxes of up to 958 Wm^{-2} , strong low-level thermally induced convergence, and additionally, cold air flow from the orographic structure at Taymir-Peninsula in the western Laptev Sea region. Based on the surface energy balance, we derive potential sea ice production rates between 8 cm d^{-1} and 25 cm d^{-1} in the Laptev Sea polynyas. The range is mainly controlled by the assumption whether the polynyas are ice-free or covered by thin ice and by the wind strength.

SIMULATION OF LAPTEV SEA POLYNIA DYNAMICS USING THE FESOM MODEL WITH DIFFERENT ATMOSPHERIC FORCINGS

T. Ernsdorf¹, G. Heinemann¹, D. Schroeder¹, S. Adams¹, A. Helbig¹, R. Timmermann², S. Willmes¹

¹Trier University, Fac. of Geography/Geosciences, Environmental Meteorology, Trier, Germany

²Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

An improved understanding and quantification of polynya effects in the Laptev Sea can be achieved by high-resolution sea ice-ocean models. Here we use the well-established Finite

Element Sea Ice-Ocean Model FESOM (5 km x 5 km) (Timmermann et al. 2009). It consists of a hydrostatic primitive-equation ocean model and a dynamic-thermodynamic sea ice model. In our study the model is forced by 6-hourly GME analyses (0.5° x 0.5°), daily and 6-hourly NCEP/NCAR reanalyses (2.5° x 2.5°) and hourly COSMO data (5 km x 5 km) to investigate a polynya event during the TRANSDRIFT winter experiment 2008. The opening process of a main polynya event on 29 April 2008 is represented with all atmospheric forcing fields (except the daily NCEP data) in a similarly good way. However, there are differences in direction and velocity of the icadrift and in the location and development of the polynyas. Small-scale meteorological structures are best represented by the high-resolution COSMO data. Because of that they are preferred as model forcing data. The maximum sensible heat flux is 220 W/m², the maximum latent heat flux is 120 W/m², the maximum advective ice thickness reduction is 5 cm/h and the maximum thermal ice thickness production is 5 mm/h.

ENVIRONMENTAL HISTORY OF THE WESTERN LAPTEV SEA SINCE THE LATE PLEISTOCENE

J. Gottschalk¹, E. Taldenkova²

¹Bremen University, Bremen, Germany

²Moscow State University, Moscow, Russia

To reconstruct postglacial environmental changes of the western Laptev Sea two marine sediment cores from the outer continental shelf (water depth 60 m) and upper continental slope (water depth 270 m) were analysed in terms of the coarse fraction (> 63 µm) variability as well as the concentration and composition of ice-rafted debris (IRD) (> 500 µm). The investigated time interval starts at 12.6 calendar ka before present (cal. ka BP), when the Laptev Sea faced rapid changes due to rising sea level. In general, the transition from a fluvial-terrestrial influenced shelf system to a mainly marine broad shallow shelf complex can be observed since the Late Pleistocene. From 7.4 cal. ka BP on, a considerable cooling of the climate connected with an enhanced iceberg transport of IRD after a preceding warm period gets evident. The IRD composition points to the archipelago Severnaya Zemlya as the source region. The regrowth of regional ice caps and an increased iceberg calving were induced by strong intrusions of Atlantic derived waters and a therewith accompanied moisture supply to the western Siberian continental margin, facilitating ice cap expansion. Furthermore, the IRD record shows a cyclicity with a period of 1400 years, which is consistent with Holocene ice rafting processes in the North Atlantic. The modern western Laptev Sea system gets established at 1.8 cal. ka BP.

COASTAL AND SUBSEA PERMAFROST STUDIES IN THE SIBERIAN SHELF-COASTAL ZONE: RESULTS AND OUTLOOK

M.N. Grigoriev

Melnikov Permafrost Institute SB RAS, Yakutsk, Russia

The coastal-shelf zone of the Arctic Seas is a place of dynamic interaction of the atmosphere, sea and permafrost. This zone of the Siberian Seas is known for active dynamics of erosive processes and subsea permafrost transformation. Shore dynamics directly reflecting the complicated land-ocean interactions plays an important role in the balance of sediments, organic carbon and nutrients in the Arctic basin. Thermal abrasion is the most important destructive phenomenon in coastal retreat in this area. Long-term

observations of coastal erosion on the key sites with ice-rich shores show that the coastal retreat rates within the study area have significantly increased (1.5-2 times) between 1999-2002 and 2009. One of the goals of the Laptev Sea System Project was to develop an understanding of the evolution of subsea permafrost within the near-shore zone of the shallow shelf. Subsea permafrost is still poorly understood, due mainly to the lack of direct observations. Studies of permafrost evolution in the coastal zone allow us to better understand the on-shore/off-shore permafrost system evolution. Coastal and offshore drilling studies in the Laptev Sea confirm the existence of frozen sediments on the shelf. On the basis of geocryological, thermal, and pore water/ice salinity data, it is possible to understand the evolution of subsea permafrost during and after sea level rise. We plan to continue research on coastal dynamics and off-shore permafrost evolution in the coastal-shelf zone of the Siberian Seas using appropriate drilling and geophysical equipment.

LENA FRESHWATER EXPORT DURING ARCTIC SUMMER

M. Groeger¹, D. Bauch^{2,3}, R. Spielhagen³

¹Max Planck Institute for Meteorology, Hamburg, Germany

²Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

³Mainz Academy of Sciences, Humanities and Literature, Mainz, Germany

The vast Siberian shelf areas receive considerable amounts of freshwater from the surrounding Asian drainage basins. The removal of this freshwater and its export to the Arctic interior across the shelf break are of great importance for the maintenance and stability of the Arctic halocline layer. The Arctic halocline layer feeds back to climate by insulating warmer and higher saline water masses at intermediate depth from the colder atmosphere. It furthermore promotes the formation of sea ice.

Mass balance calculations based on oxygen stable isotope and salinity data from the 2007 TRANSDRIFT XII expedition on the Laptev Shelf indicate the Lena freshwater plume drifted to the east keeping most of the freshwater on inner shelf rather than exporting it to the Arctic interior. This is supported by numerical simulations using a 3D primitive equation continental shelf model which is forced by Global Model Extended reanalysis data provided by subproject 4, and NCEP 10 m winds. The model results indicate a strong freshwater export to the eastern Laptev Sea during summer 2007.

ATMOSPHERIC CONDITIONS DURING TRANSDRIFT 2008/09 AND COMPARISON TO CLIMATOLOGY

G. Heinemann, D. Schroeder, A. Helbig, D. Kramer

Trier University, Fac. of Geography/Geosciences, Environmental Meteorology, Trier, Germany

How representative are the atmospheric conditions in the Laptev Sea during the TRANSDRIFT field experiments in April 2008 and March 2009 with respect to climatological conditions? For classification we compare GME analyses data of the German Weather Service for April 2008 and March 2009 with NCEP/NCAR reanalyses data for the period 1979-2007. The April 2m air temperature values are slightly below climate means, but the differences are smaller than the standard deviation based on April 1979-2007. April 2008 is not an unusual April, but the wind distribution indicates weaker wind forcing on the West New Siberian (WNS) polynya than in climate average. In March 2009 the mean 2 m air temperature is nearly 10 K colder than in April 2008 and 3-6 K colder than the March climate

mean. March 2009 is unusually cold which would increase the ice production rate, but the forcing for the Anabar-Lena polynya and the WNS polynya is expected to be smaller than in climate average due to the wind distribution. In general, openings of the Western Laptev Sea polynyas are more likely in the early winter and openings of the WNS Polynya more likely in March and April.

METEOROLOGICAL OBSERVATIONS DURING LAPTEV SEA WINTER EXPERIMENTS 2008 AND 2009

A. Helbig¹, G. Heinemann¹, S. Adams¹, T. Ernsdorf¹, T. Krumpen², J. Hoelemann², H. Kassens³, T. Klagge³, S. Kirillov⁴, V. Vizitov⁴

¹Trier University, Fac. of Geography/Geosciences, Environmental Meteorology, Trier, Germany

²Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

³Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

⁴Arctic and Antarctic Research Institute, St. Petersburg, Russia

During the expeditions TRANSDRIFT XIII and TRANSDRIFT XV the meteorological regime has been studied at different sites along the ice edge of West New Siberian (WNS) polynya in high temporal resolution using Automatic Weather Stations (AWS) as well as an airborne radiation pyrometer KT 15 P II. AWS observations comprise measurements of wind, temperature, humidity, net radiation and surface temperature near the fast ice edge. The data were post-processed (including calibration and validation) and are available as 10min and 1h averages. Airborne data were collected by helicopter flights over the polynya including measurements of the surface temperature with very high spatial resolution and a photogrammetric sea-ice survey were performed during 2009. These data are used to validate the numerical models of the Arctic atmosphere (NCEP, GME, COSMO) and to provide meteorological information for other subprojects (oceanography, ice physics). The surface temperature data will be used to retrieve the thin ice thickness (TIT) and compared with satellite remote sensing methods.

THE LAPTEV SEA BOTTOM LAYER HYDROGRAPHY: 2007-2009 SEASONALITY AND IMPACTING FACTORS

S.A. Kirillov¹, I.A. Dmitrenko², M.S. Makhotin¹, J.A. Hoelemann³, E.V. Bloshkina¹

¹Arctic and Antarctic Research Institute, St. Petersburg, Russia

²Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

³Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

Arctic sea ice extent during the 2007-2009 melt seasons dropped to the lowest levels since satellite measurements began in 1979. Both the longer ice-free season and positive anomalies in air temperatures resulted in an enhance of heat accumulation in the inner shelf waters of the Laptev Sea. The earlier ice melting in 2007 resulted in extra-heating in the central Laptev Sea up to 5°C higher than the 1932-2006 mean in the surface layer. Vertical wind-driven mixing favored these anomalies penetrating down to the bottom layer beneath the seasonal pycnocline.

The analysis of two long-term mooring stations deployed in 2007-2009 in the central Laptev Sea (Anabar and Khatanga) allowed us to trace the fate of the heat accumulated in summer during the next winter. It was revealed that western winds resulted in sporadic temperature increase near the bottom even after the air temperature had dropped down below zero.

Since the fast ice is stabilized, the ventilation through the polynya starts to deplete the heat in the bottom layer. These ventilation events are observed until April-May when the positive anomaly of bottom temperatures completely disappears.

TRANSDRIFT XII - XVI: TECHNICAL IMPLEMENTATIONS AND NEW APPROACHES FOR MEASURING AND RETRIEVING DATA

T. Klagge

Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

This will be a short excursion on how data was taken during the summer cruises TRANSDRIFT XII, XIV and XVI as well as during the winter experiments TRANSDRIFT XIII and TRANSDRIFT XV. The focus is put on oceanographic and bio-chemistry sampling and the corresponding devices, and how these devices were able to fulfil their task. Throughout all the expeditions that were carried out by our project we were faced with the extreme environmental conditions in our research area. Taking this into account, many of the common tools and instruments had and have to be adapted to this harsh and remote environment. Therefore I will shortly introduce experiences we had with common scientific equipment, the changes and modifications we had to make to it, as well as the complete new approaches that were necessary to measure and to retrieve needed data. This talk includes our moored seafloor observatories with and without SCOUTS, our oceanographic ice-tethered short-term observatories as well as our NEMO floats.

OBSERVATION AND MODELLING OF THE WEST NEW SIBERIAN POLYNYA DURING TWO SEASONAL CYCLES

T. Krumpen¹, J.A. Hoelemann¹, T. Busche², I. Dmitrenko³, C. Haas⁴, S. Hendricks¹, R. Gerdes¹, S. Kirillov⁵, T. Klagge³, L. Rabenstein¹, M.A. Morales Maqueda⁶, P. Rozman¹, D. Schroeder⁷, S. Willmes⁷

¹Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

²German Aerospace Center (DLR), Wessling, Germany

³Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

⁴University of Alberta, Edmonton, Canada

⁵Arctic and Antarctic Research Institute, St. Petersburg, Russia

⁶Proudman Oceanographic Laboratory, Liverpool, UK

⁷Trier University, Fac. of Geography/Geosciences, Environmental Meteorology, Trier, Germany

A flux model was applied to simulate an opening event of the West New Siberian (WNS) polynya observed during TRANSDRIFT XIII. Aim was to aid interpretation of in-situ hydrographic measurements (M1 and M2) made along the fast ice edge and judge polynya's potential for dense water formation. Beforehand, the accuracy of the model was validated by comparing simulations with satellite, airborne and in-situ measurements. Furthermore, the sensitivity of the model to different parameterisations for the consolidation thickness $/H/$ was tested.

The comparison of observed and simulated thickness of the thin ice zone shows that the model is well tuned and applicable to the WNS polynya. The formulation of $/H/$ developed by $/Biggs/$ provides the most realistic parameterization.

Model results show that 2.2 km³ of produced ice reject about 24.6 Mt of salt, whereby 9.0 Mt (36 %) is rejected during frazil ice formation in open water. Neglecting any advection, salt

rejection at M1 is high enough to induce convective mixing down to 15 m. The vertical density stratification at M2 is stronger and cannot be destratified by salt rejection alone. This is contrary to CTD observations made 3 days after the opening event at M2.

SOURCES AND DELIVERY OF A SEDIMENTARY MATERIAL TO THE CENTRAL ARCTIC OCEAN DURING PLEISTOCENE-HOLOCENE (RESULTS FROM THE ORGANIC-GEOCHEMICAL AND LITHOLOGICAL INVESTIGATIONS)

A.V. Kursheva, I.V. Litvinenko, A.A. Krylov, V.I. Petrova

VNIIOkeangeologia, St. Petersburg, Russia

The main purpose of this study is to determine the factors that control the formation of Late Cenozoic sediments of the region depending on morphostructural and lithologic-facial features of sedimentation.

The materials of this study were sedimentary columns received during the expedition of atomic icebreaker "Russia" (2007) on the meridional profile along the centreline of the Lomonosov Ridge (AR-07-18, AR-07-28) and on the Lomonosov Ridge slope to the Makarov Basin (AR-07-15).

Similarity of the lithology in the both stations (AR-07-18, AR-07-28) is most likely caused by equal sedimentary environments. Two basic mechanisms of the sediments accumulations can be evoked. Ice-rafting mechanism was most likely the major agent for delivery of sediments during formation of the upper part of the sections. Because of the topographic position of the station AR-07-15 on the slope of the Ridge, the process of sedimentation was most likely complicated by the suspension/turbidities flows.

The average content in the sediments (AR-07-28) of organic carbon (C_{org}) does not exceed 0.22%, which is typical for the deep Arctic basin sediments. Typical are also a low content of bitumoides and the absence of humic acids (HA). However, in the lower part of the section (>800cm) is observed the increase of DOM ($C_{org} > 0.50\%$) and its soluble components (bitumoides). This significantly reduces the maturity degree of DOM. This change may be due to intensive income of sediment material enriched weakly transformed terrigenous (humus) organic matter.

A similar pattern is observed on the station AR-07-18. This indicates a low (early-diagenetic) maturity degree and mostly humus genesis of the organic component of sediments of this part of section.

Bottom sediments from station AR-07-15 by geochemical parameters of DOM differ from the above, and may be conditionally divided at 3 intervals. This specificity of the geochemical characteristics can be attributed to a change in the ratio of the various sources of sedimentary material. Sedimentary material containing DOM of post-diagenetic maturity level can be introduced (ice rafting) or local redeposition (suspension flows).

STUDY ANCIENT DNA ON PALEONTOLOGICAL COLLECTION OF THE JOINT RUSSIAN-GERMAN EXPEDITIONS 1998 – 2007 YEARS

T.V. Kuznetsova

Moscow State University, Moscow, Russia

Perennially frozen sediments in Arctic Siberia provide a perfect preservation of organic remains. The collection and study of paleontological material were the part of

multidisciplinary research Late Pleistocene and Holocene deposits on coasts of the Laptev Sea, Lena Delta Region and the New Siberian Islands. About 4000 fossil mammal bones have been found. In contradiction to the other collections our one is unique by 100% registration of all bone findings. Such an approach gives the possibility to understand the composition of mammal populations that lived in these areas during the Late Quaternary.

DNA investigations of different animal species are mainstream of modern biology. Our collection with a lot of dated bones gives very rare chance to understand variety, ecology, phylogeography and phylogenetic extinction species, changing Late Pleistocene - Holocene paleoenvironment conditions. Using our material we identified genetic signatures of an expansion of *Mammuthus primigenius* from eastern to western Beringia after the Last Interglacial and then an extended period during which demographic inference indicates no population-size increase. It could be the reason of such fast extinction of woolly mammoth (Barnes et al., 2007). The reconstructed whole mitochondrial genome (Gilbert et al., 2007) indicated woolly mammoth is close to the Indian elephant. Finds of the *Coelodonta antiquitatis* hair allowed us to get whole mtDNA of woolly rhinoceros and ascertained relationships of *Rhinocerotidae* (Willerslev et al., 2008). Bones of cave lion and bison were the material of comparative phylogeography investigations of these species during Late Pleistocene (Shapiro et al., 2002; Barnett et al., 2009). Bones from the permafrost of Laptev Sea Region help understand origin of domestic horses too (Lippold et al., in press).

We thank all German and Russian colleagues who took part in expeditions, especially L. Schirrmeister, V. V. Kunitsky, V.E. Tumskoy for their help. We are also thankful to Otto Schmidt Laboratory for the partial support of this work (projects OSL-07-07, OSL-09-13).

VARIABILITY OF PACIFIC ORIGIN WATER IN THE ARCTIC OCEAN

M. Makhotin and L.A. Timokhov

Arctic and Antarctic Research Institute, St. Petersburg, Russia

Due to hydrostatic imbalance and atmospheric circulation, water from the North Pacific flows through the Bering Strait, transits the upper levels of the Arctic Ocean, and finds its way to the North Atlantic.

Using hydrographic and hydrochemical data (1950-1993), annual wintertime fields of thickness, volumes and boundaries positions of Pacific origin water (POW) are estimated.

We found a significant interannual variability of POW circulation, which is influenced by the atmospheric processes associated with changes in atmospheric climate modes (i.e. the Arctic Oscillation (AO), sea level pressure difference and etc.). We revealed that processes in the North Pacific determine the variability of water discharge through the Bering Strait and the volume of POW in the Arctic Ocean and the circulation over the Arctic determines the position of POW in the Arctic Basin and transit time from Bering to Fram Straits.

METEOROLOGICAL INVESTIGATIONS ON THE DRIFTING STATIONS “NORTH POLE” IN 2007-2009

A. Makshtas, S. Shutilin, N. Zinoviev, V. Kustov

Arctic and Antarctic Research Institute, St. Petersburg, Russia

One of the actual hydrometeorological problems is the problem of climate change in the Arctic regions under natural and anthropogenic reasons. Modeling is the main tool for under-

standing and prediction of recent and future climate. Same time the success of modeling depends on description of physical processes. In the Polar Regions, the most important are the processes of air-sea ice-ocean interaction. Despite many years of investigations, there are some shortcomings in its descriptions. During experiments on the drifting stations “North Pole-35, 36” in 2007-2009 in frame of Russian (AARI)-German (AWI) collaboration unique datasets on meteorology, radiosounding, radiation and cloudiness had been obtained. In presentation the preliminary results of experimental studies of energy-mass exchange processes, redistribution of solar radiation in system “atmospheric surface layer/sea ice/ocean upper layer”; surface-based inversions and low-level jets in the atmospheric boundary layer are presented.

RADIATION CHARACTERISTICS, CDOM, AND SUSPENDED MATTER IN THE KARA AND LAPTEV SEAS

A. Makshtas, A. Smirnov, R. Vlasenkov

Arctic and Antarctic Research Institute, St. Petersburg, Russia

New data about radiation characteristics and concentration of suspended matter in the Kara and Laptev Seas obtained during expeditions 2007 and 2008 are analyzed together with oceanographic data. The results of laboratory analysis of collected water samples on concentration of suspended matter and CDOM in the upper and bottom layers are shown. The preliminary estimations of the influence of sea water optical properties in study areas on the radiation heating of sea upper layer, important for accounting the role of this process in the numerical sea ice models, are presented.

CHLOROPHYLL A PATTERNS IN THE LAPTEV SEA IN SEPTEMBER 2007

F. Martynov¹, E. Abramova², A. Novikhin¹, J.A. Hoelemann³

¹Arctic and Antarctic Research Institute, St. Petersburg, Russia

²Lena Delta State Nature Reserve, Tiksi, Russia

³Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

Despite a number of works dedicated to researches of primary production, chlorophyll patterns and nutrient supply in the arctic seas most of them dedicated to Barents and Kara seas, or got data from satellite-borne observations (Chlorophyll *a*) which have a problem with calibrating data particularly in regions with waters which are affected by river runoff with high concentrations of colored detrital matter. So by this moment the most reliable and available method to estimate Chlorophyll *a* is fluorometrically processing organic matter filtered from the water column. Also new fluorometrical sensor for CTD measuring available for researches.

Combining these two methods in September 2007 we tried to obtain full data for Laptev Sea and estimated influences of river runoff and ice zone on the Chlorophyll *a* concentrations and its vertical distribution in the whole water column.

Data were obtained during TRANSDRIFT XII expedition on R/V “Ivan Petrov” cruise in the Laptev Sea from August 29 to September 17, 2007. According to our data in the shallow area of the shelf nearby Lena Delta Chlorophyll *a* distribution shows 2 basic patterns. Shallow (10-20 m depth) well-mixed zone with high nutrient supply from remineralization of the bottom sediments leads the situation with high productivity and as consequence high (0.8-1.2 mg/m³) Chlorophyll *a* values. In 2007 this zone was limited by 74°30N and 125°00E.

River frontal zone with high nutrient values was situated in the upper 5 m depth level with average values of Chlorophyll *a* 0.53 mg/m³ and maximum 0.67 mg/m³. This pattern have patchiness distribution and belongs to frontal river influence zone with limits to 75.00°N.

The northern stations situated along 126°00E transect from 76.00°N to 77.30°N near the shelf slope have similar patterns of vertical Chlorophyll *a* distribution. Maximum of values observed on these stations were situated right under the pyknocline with average value of 1 mg/m³. This zone was situated near ice margin (20-50 nm out of border) and have signs of influence from the ice frontal zone.

During the daily station at 76.73°N to 126.00°E we found 3 peaks of Chlorophyll *a* values (at 9, 15 and 24 hours) on 20-25 m depth with highest value observed on this expedition at station # IP07_2_180 (15 hours) with 15.7 mg/m³. The patches with high values and small area distribution near the marginal ice zone could play the basic role in primary production for northern part of the Laptev Sea.

ARCTIC COPEPODS IN A CHANGING SUB-ARCTIC SEA: IS SPECIES SUCCESS POSSIBLE?

D. Martynova¹, N. Kazus², N. Mingazov³, Ks. Mikhachuk³, N. Usov¹, I. Kutcheva¹

¹Zoological Institute RAS, St. Petersburg, Russia

²P.P. Shirshov Institute of Oceanology RAS, Atlantic Branch, Kaliningrad, Russia

³St. Petersburg State University, St. Petersburg, Russia

Reliable predictions of marine food web responses to climate change require understanding of the coupling mechanisms between trophic levels. Most pelagic species not only have temperature preferences, but also depend strongly both on food seasonality and the light regime. The continuous investigations on the White Sea reveal unprecedented shortage of ice cover season for the last decade and increasing of annual sea surface temperature in 0.6°C since 1957. The study was aimed to study major ecological peculiarities of two key arctic copepod species, *Calanus glacialis* and *Metridia longa*, including their demecology, feeding and reproduction characteristics with special reference to the environment. These species differ greatly in their feeding and reproduction ecology and life cycle strategies. *C. glacialis* appears to employ "spring herbivorous" type of the life cycle, while *M. longa* as omnivore depends mostly on the autumn conditions. Being affected by shortage of ice cover season, i.e. food regime in spring, *C. glacialis* may decrease species success. However, we tend to describe local ecotype of *C. glacialis* in the White Sea, which may appear more sustained comparing to the high-Arctic populations. *Metridia* seems to be less affected by spring conditions and may have more chances to sustain its population successfully.

MONITORING KEYSTONE COMPONENTS OF SUB-ARCTIC FOOD WEBS – ECOSYSTEM DYNAMICS OF THE WHITE SEA

D. Martynova¹, N. Mingazov², N. Kazus³, N. Usov¹, I. Kutcheva¹

¹Zoological Institute RAS, St. Petersburg, Russia

²St. Petersburg State University, St. Petersburg, Russia

³P.P. Shirshov Institute of Oceanology RAS, Atlantic Branch, Kaliningrad, Russia

Climate change has become increasingly obvious in recent decades, both for sub-Arctic as well as Arctic regions. Continuous observations of the White Sea reveal an unprecedented reduction in the ice coverage season over the last decade and increasing annual sea surface

temperatures (0.6°C since 1957). The abundance of *Calanus glacialis*, while showing large variability and a certain dependence on the previous year's abundance, appear to be negatively related to increases in surface temperature, thus being open to warming impacts. Monitoring observations not only provide data on the past and ongoing changes, but would also provide early warnings of future trends in ecosystem parameters. Because predictive capacity increases with the number of observations, long-term, multi-variable monitoring is essential to ensure we make reliable predictions of future ecosystem state. Under a warming Arctic and sub-Arctic scenario the White Sea will be deeply affected, as past records indicate. A shorter ice cover period is likely to reduce the success of key species such as *Calanus glacialis*. This will mostly be due to a mismatching between spring phytoplankton bloom and copepod gonad maturation and reproduction. This mismatch will decrease copepods energy resources during their most vulnerable period. It is expected that this prediction will apply to other species as well. Further investigations are needed to assess ecosystem changes and support future management options.

The study was supported by Otto Schmidt Labor fellowships (OSL-07-11 and OSL-09-16), EUR-OCEANS Network of Excellence (project 511106-2) and Russian Foundation for Basic Researches (project N 08-04-98843-p_sever_a).

NUTRIENTS AND CHLOROPHYLL A DISTRIBUTION IN THE LAPTEV SEA FRONTAL ZONES ACCORDING TO 2007-2009 SUMMER DATA

A. Novikhin¹, F. Martynov¹, E. Abramova², J.A. Hoelemann³, D. Bauch^{4,5}

¹Arctic and Antarctic Research Institute, St. Petersburg, Russia

²Lena Delta State Nature Reserve, Tiksi, Russia

³Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

⁴Mainz Academy of Sciences, Humanities and Literature, Mainz, Germany

⁵Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

Hydrochemical investigations are important for environmental monitoring. Dissolved oxygen accumulates in seawater due to photosynthesis and seawater-atmosphere exchange. It is then utilized for respiration and decomposition of organic matter. Nutrients (silicon, phosphates, nitrites, nitrates) form the mineral basis of primary production. The Chlorophyll *a*, together with nutrients, determines the potential region primary production and influence on the total state of the ecosystem. Combined with temperature and salinity hydrochemical parameters provide evidence for the water masses distribution and allow to reveal biogeochemical processes in the frontal zones.

In summer cruises of 2007-2009 an ample amount of nutrients and Chlorophyll *a* data was collected in the Laptev Sea. The data analysis was focused on revealing of nutrients and Chlorophyll *a* distribution peculiarities in the river plume and ice margin frontal zones. The 126°E and 74° 20'N transects were selected to describe the nutrients and Chlorophyll *a* distribution, interannual changes and anomalies.

In 2007 the stronger than average river runoff influence was recorded in the eastern and southeastern regions, where surface waters were warmer than usual and depleted in dissolved oxygen. That was accompanied with extremely low ice extension and local chlorophyll peak in the ice marginal zone. Another peculiarity of this year is well expressed maximum of dissolved oxygen in the intermediate water layer. The similar distribution was observed in summer of 2009. That pattern is enforced by the synoptic situation and appeared as the eastern type of river plume extension in the Laptev Sea. It characterized with the low temperature low oxygen high salinity and high nutrient bottom waters and onshore pressed river plume, shifted eastward.

In 2008 the river plume was extended more northward in the central part of the Laptev Sea.

The intermediate high oxygen layer in the northern part of the sea is not so well pronounced but the absolute oxygen magnitudes are higher. This year all Laptev Sea central part was functioning as a wide frontal zone.

LATE PLEISTOCENE TO HOLOCENE ENVIRONMENTAL CHANGES IN THE LAPTEV SEA INFERRED FROM FOSSIL ASSEMBLAGES OF CALCAREOUS BENTHIC FORAMINIFERS

Ya.S. Ovsepyan¹, E.E. Taldenkova¹, I.A. Pogodina², H.A. Bauch³

¹Moscow State University, Moscow, Russia

²Murmansk Marine Biological Institute, Murmansk, Russia

³Mainz Academy for Sciences, Humanities and Literature, Mainz, Germany

In order to reconstruct paleoenvironmental conditions in the Laptev Sea during the postglacial sea-level rise benthic calcareous foraminifers were investigated in three AMS¹⁴C dated cores from the mid-outer shelf and upper continental slope within the water depth range of 45 to 270 meters. Reconstructions are based on the time dependent abundance and diversity changes and variations in the relative abundance of species and ecological groups distinguished in the arctic marginal seas in dependence to offshore changes in water depth and river runoff influence (river-proximal, river-intermediate and river-distal ones, Polyak et al., 2002). The index species to trace the subsurface penetration of chilled Atlantic-derived waters (ADW) is *Cassidulina neoteretis*.

Benthic foraminiferal record of the core from the slope spans the time period 15.6-2 cal.ka, although rare tests including *C. neoteretis* were also found in the layer with extrapolated age of 17 cal.ka from the basal almost fossil-barren part of the sequence. As it also contains abundant small-sized subpolar planktic foraminifers this implies occasional inflows of ADW. The enhanced subsurface inflow of ADW evidenced by the highest percentages of *C. neoteretis* is recorded 15.6-12 cal.ka prior to extensive shelf flooding, when the generally cold-water environmental conditions with extensive sea-ice cover prevailed as manifested by the dominance of *Cassidulina reniforme* and *Elphidium clavatum*. *C. neoteretis* disappears from the record between 12 and 5 cal.ka which could be due to the considerable freshening of the upper water column resulting from climate warming and active shelf flooding. Surface water warming and enhanced primary productivity 12-10 cal. ka due to strong water stratification and proximity to the summer sea-ice margin are indicated by the spikes in the relative abundance of *Nonion labradoricum*, *Islandiella* spp., *Pyrgo williamsoni*. Establishment of modern-like conditions is evidenced by growing abundance of *Melonis barleeanus* and re-appearance of *C. neoteretis* since 5 cal.ka.

Fossil assemblages from the shelf cores demonstrate time transgressive changes from impoverished nearshore environments (*E. clavatum* and river-proximal species) to the present outer shelf settings (river-intermediate and river-distal species).

SEA-ICE ALGAL AND ICE-EDGE PHYTOPLANKTON COMMUNITIES FROM THE LAPTEV SEA POLYNIA, IN APRIL 2008

Ye.I. Polyakova, T.S. Klyuvitkina, L. Astakhova

Moscow State University, Moscow, Russia

Spring sea-ice and phytoplankton samples were collected from the Laptev Sea polynya area during the TRANSDIFT-XIII expeditions. Results of study of microalgae in these samples

revealed the following peculiarities of their vertical and spatial distribution patterns.

The vertical distribution of phytoplankton according to obtained records are characterized by the overall decrease of algal abundances and biomass with water depth. The sharp decrease of algal abundances observed below 10-15 m in most Stations with two exceptions. Diatoms and dinoflagellates contributed the most of algal abundances and biomass in phytoplankton samples. Diatoms dominated the algal assemblages in most Stations, and their relative abundances generally decreased with depth. The dominant species composition was variable among stations.

The length of studied sea-ice cores varied between 57 and 145 cm. The vertical distribution of microalgae in the ice was studied in upper, middle and bottom samples, as indicators of surface, interior and bottom assemblages. Obtained by now records revealed the following general regularity in distribution patterns of abundances, biomass and species composition of microalgae in sea-ice cores: 1) increase in several times of abundances and biomass in the bottom assemblages in comparison with surface and interior assemblages; 2) predominance of diatoms in algal assemblages in all studied samples; 3) high taxonomical diversity of diatoms in the studied sea-ice samples, and predominance of sea-ice, marine planktonic and epiphytic species; 4) persistent occurrence of freshwater, mainly riverine diatoms with low abundances and biomass.

HELICOPTER ELECTRO MAGNETIC SEA-ICE THICKNESS SURVEYING DURING TRANSDRIFT XIII

L. Rabenstein

Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

Helicopter Electro Magnetic (HEM) surveying is one of the few methods to obtain wide area in-situ sea-ice thickness data. For a complete estimation of sea-ice volume and sea-ice mass produced in the West New Siberian Polynya information about the local sea-ice thickness distribution is inevitable. During TRANSDRIFT XIII the so called EM-Bird of the Alfred-Wegener-Institute was applied for the first time in the Laptev Sea. Results were used to validate thickness measurements based on near infrared thermal radiation data and to validate model studies. Furthermore, we obtained sea-ice thickness distributions of thicker ice in the pack ice region beyond the active polynya zone. There we clearly identified two thickness modes of 0.8 m and 1.5 m which refer to sea-ice from polynya events earlier that winter. In order to quantify sea-ice growth within the expedition time two profiles were flown along the same geographical positions but 12 days apart of each other. These profiles showed that thin ice grew about 0.2 m but thicker ice only by an amount smaller than the instrument accuracy of 0.1 m.

TRACKING OF SYNOPTIC WEATHER SYSTEMS IN THE SIBERIAN ARCTIC AND THEIR IMPACT ON THE LAPTEV SEA POLYNIA

C. Radermacher¹, G. Heinemann²

¹Bonn University, Meteorological Institute, Bonn, Germany

²Trier University, Fac. of Geography/Geosciences, Environmental Meteorology, Trier, Germany

Synoptic weather systems in the Arctic are studied using a track algorithm based on a feature-tracking method. The tracking is performed with the 850 hPa relative vorticity field derived from the NCEP/NCAR reanalysis dataset for the winter seasons 1978-2007. A

climatology of synoptic systems is calculated for the whole Arctic. A low cyclone track density is found for eastern Siberia and the Pacific part of the Arctic. Cyclonic and anticyclonic track density decreases from the first half to the second half of the 30-year investigation period in large parts of the Arctic. The reaction of the Laptev polynya to tracks of cyclones and anticyclones is investigated by selecting favourable track directions. The Anabar-Lena Polynya is affected by cyclones moving eastwards across the Laptev Sea. These cyclones cause an opening of the polynya on the day before the cyclone passage and a closing on the day after. The West New Siberian Polynya (WNS) is affected by cyclone tracks moving northwards along the western flank of the Laptev Sea. The cyclones mainly have an opening impact one and two days before the cyclone passage. For the WNS polynya, anticyclones passing from the east have the largest effect.

ROLE OF THE FAST ICE IN AN ARCTIC SEA ICE – OCEAN COUPLED MODEL

P. Rozman, R. Gerdes, C. Koeberle

Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

Fast sea ice edge plays a dominant role in positioning of flaw polynyas - winter sea ice production and dense water formation areas of the Arctic shelf seas. In this study we integrate the Laptev Sea fast ice into a coupled ice-ocean model. Prior to parameterization the simulated flaw polynya did not occur at the fast ice edge, but directly at the coast instead. The dislocation of the polynya resulted in severe regional biases in sea ice and ocean parameters. After including the landfast ice in the model the polynya is positioned correctly, thus significantly improving the representation of sea ice concentration, ocean temperature and salinity distribution. The results of the improved model reflect the importance of the fast ice for the shelf circulation. The model run with the fast ice results in stronger stratification, enhanced estuarine circulation and dense water formation compared to the model run without the fast ice. The validation of the ice concentration with the satellite remote sensing products shows satisfactory results. The ocean parameters still need to be validated with the observational data.

LONG-TERM CHANGES OF EXTREME LEVELS OF ARCTIC SEAS AND THEIR REASONS

I. Ryzhov

Arctic and Antarctic Research Institute, St. Petersburg, Russia

This study is focused on regularities between surges, the trajectory of the cyclone movement and the ice regime during the period from 1954 to 2007. Statistical data processing of sea-level changes over the past 60 years, recorded by 64 monitoring stations located in the four Arctic seas, analysis of extreme fluctuations of the sea-level, data of the pressure and ice conditions.

We found that in the last 20 years maximum annual amplitudes of sea-level fluctuations have statistically significantly decreased by 1 cm per year along with increase of average sea-level in the arctic seas. And the position of the ice edge and the trajectories of the cyclone motion have generally shifted to the north in all the seas of the Eastern Arctic. The rate of this displacement is about 0.1 degrees per year. Such behavior can be explained by the following assumptions:

We have assumed the relationship between the decrease of the maximum annual amplitude of sea-level oscillations in the Arctic Ocean and the global warming. And we suppose that the trajectories of the cyclones movement follow the sea ice in the Arctic Ocean, and the ice edge, in turn, is pushed off the shore. This may lead to decrease of atmospheric activity along the shoreline and decrease of the average amplitude of sea-level fluctuations.

Probably, the displacement of trajectories of the cyclones movement to the north is caused by a shift edge of the ice fields in the Arctic to the north due to global warming of the Earth's atmosphere.

POLYNYA STUDIES IN THE LAPTEV SEA WITH A FULLY COUPLED HIGH RESOLUTION ATMOSPHERE-SEA ICE-OCEAN MODEL

D. Schroeder¹, G. Heinemann¹, L. Ebner¹, T. Ernsdorf¹, S. Adams¹, S. Willmes¹, R. Timmermann²

¹Trier University, Fac. of Geography/Geosciences, Environmental Meteorology, Trier, Germany

² Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

According to recent studies around 25 % of the sea ice exported through the Fram Strait is produced in the Laptev Sea. The Laptev Sea polynyas are very effective ice producers due to the dominating southerly winds during wintertime which cause the openings and the transport of sea ice into the central Arctic. However, all these estimations based on coastal weather stations, coarse resolution modelling or modifications in the ocean comprise a huge degree of uncertainty. We have coupled the non-hydrostatic atmospheric model COSMO (Consortium for Small-Scale Modeling, Deutscher Wetterdienst) with the Finite Element Sea Ice Ocean Model (FESOM, Alfred Wegener Institute) for the Laptev Sea with a horizontal resolution of 5 km. This fully coupled model enables us to quantify ice production and polynya, ABL and salinity modifications on short time scales (~hours). Several polynya case studies are performed and compared with stand-alone simulations for the atmosphere and the sea ice as well as remote sensing and in-situ data obtained during the field experiment TRANSDRIFT XIII in April 2008 (BMBF project "Laptev Sea System: The Eurasian Shelf Seas in the Arctic's Changing Environment: Frontal Zones and Polynya Systems in the Laptev Sea").

IMPLEMENTATION OF A THERMODYNAMIC SEA ICE MODULE IN THE NWP MODEL COSMO AND ITS IMPACT ON SIMULATIONS FOR THE LAPTEV SEA AREA IN THE SIBERIAN ARCTIC

D. Schroeder, G. Heinemann, S. Willmes

Trier University, Fac. of Geography/Geosciences, Environmental Meteorology, Trier, Germany

Previous versions of the numerical weather prediction model COSMO (Consortium for Small-Scale Modeling) have used a constant sea ice surface temperature, but observations show a high degree of variability on sub-daily time-scales. To account for this, we have implemented a thermodynamic sea ice module in COSMO and performed simulations at a resolution of 15 km and 5 km for the Laptev Sea area in April 2008. Temporal and spatial variability of surface and 2m air temperature are verified by four automatic weather stations deployed along the edge of the West New Siberian Polynya during the TRANSDRIFT XIII-2 expedition and by surface temperature charts derived from MODIS satellite data. A remarkable agreement between the new model results and these observations demonstrates that the implemented sea ice module can be applied for short range simulations. Our COSMO

simulations provide a high resolution and high quality atmospheric data set for the Laptev Sea for the period 14 to 30 April 2008. Based on this data set, we derive a mean total sea ice production rate of 0.53 km³/day for all Laptev Sea polynyas. Our results indicate that ice production in Laptev Sea polynyas has been overestimated in previous studies.

RUNOFF MODELLING AT ARCTIC BASINS – RIVER LENA

O. Semenova

State Hydrological Institute, St. Petersburg, Russia

Predicting rivers flow characteristics in Arctic climate has become increasingly important because of the dominant role that river runoff plays in determination of permafrost ecosystems state and high vulnerability of the region to global climate and anthropogenic changes. The ability of hydrological models to simulate runoff formation processes, calculate streamflow from polar river basins and variable states of soil and snow cover is critical to an understanding of the permafrost hydrological cycle.

This presentation will aim to demonstrate the possibility of “Hydrograph” model application for runoff simulations at large-scale basins, as well as for fine time step representation of individual hydrological process at the local and medium- scales. The research object is the area of continuous permafrost at Eastern Siberia – the Lena river basin representing different landscape characteristics such as tundra, forested tundra, plain and mountain taigas.

Modelling results for twenty years period with daily time interval including streamflow hydrographs and state variables of soil and snow will be presented for the set of sub-watersheds with basin area from a few ha to 2.4 mln km². The main used concepts and approaches of the model will be described.

RECENT THERMOHALINE CHANGES OF THE FRONTAL ZONES IN THE LAPTEV SEA: RESULTS OF TRANSDRIFT XII (BARKALAV-2007) AND XIV (BARKALAV-2008)

I. Sergienko

Master Program for Applied Polar and Marine Sciences POMOR, St. Petersburg State University, St. Petersburg, Russia

Siberian regions, adjacent to Laptev Sea, are the most important source of the Arctic Ocean fresh water, therefore making an impact on its thermohaline structure and ice cover formation. Furthermore, sea ice influences global climatic system alteration. The main problem to determine long-lasting tendency of fresh water accumulation and thermohaline structure change and to achieve a common understanding of the processes in the region, is caused by high degree of thermohaline characteristics interannual and spatial variability, as well as insufficient spatio-temporal data coverage on the Laptev shelf.

This poster describes the thermohaline structure changes in Laptev Sea frontal zone in 2007-2008, and the determination of the influence of various hydrometeorological conditions on those changes.

Observation data was collected during summer expeditions BARKALAV-2007 and BARKALAV-2008. The BARKALAV expeditions to the Kara Sea, Barents Sea, Laptev Sea and East Siberian Sea were launched onboard research vessel “Ivan Petrov”, and were realized by the Arctic and Antarctic Research Institute, in the framework of the International Polar Year 2007/08 and the Russian-German cooperation Laptev Sea System.

RECENT AND LONG-TERM CHANGES IN AEOLIAN TRANSPORT AND FLUXES OF MATTER IN THE ARCTIC ENVIRONMENT

V.P. Shevchenko, N.V. Goryunova, D.P. Starodymova

P.P. Shirshov Institute of Oceanology RAS, Moscow, Russia

The Arctic greatly influences the environment of the Earth. Very fragile equilibrium between its physical, chemical and ecological parameters (depended on low rates of reduction of biological resources) makes the Arctic an indicator of the global change.

Recent and long-term changes in aeolian and ice transport and fluxes of matter in the Arctic environment are studied. The balance calculations show that the contribution of aerosols to sedimentary material formation in the Arctic is close to the contribution of river particulate matter beyond the marginal filters of rivers. Snow chemistry is an important indicator of aeolian transport of many chemical elements and compounds. The drifting ice accumulates airborne materials (including ecotoxicants) and transports them to the areas of ice melting.

Natural records (archives) allow a retrospective look at times when human forcing of geochemical cycles was insignificant as well as when it began, and how this forcing changed over time. Lake sediments, ice and peat cores are used to reconstruct past changes in heavy metal deposition on temporal scales.

New data on aeolian and ice transport and fluxes of matter (including ecotoxicants) in the Arctic environment (Central Arctic, Svalbard, Arkhangelsky Region, Solovetsky Islands, Canadian Arctic) have been obtained. The elemental composition of aerosols, snow, lichens, mosses and peat reflects the aeolian delivery of many elements. At the end of XX century – beginning of XXI century aeolian transport of pollutants from the Europe, Siberia and Northern America to the Arctic decreases, but the delivery of heavy metals and some other pollutants from the China increases at the same time.

PRELIMINARY RESULTS OF MACROBENTHIC ORGANISM DISTRIBUTION IN THE LAPTEV SEA POLYNIA IN WINTER 2009

G. Soloviev¹, F. Martynov², D. Taborskiy², E. Abramova³

¹St. Petersburg State Polytechnical University, St. Petersburg, Russia

²St. Petersburg State University, St. Petersburg, Russia

³Lena Delta Nature Reserve, Tiksi, Russia

There were conducted many investigations of benthos distribution in Laptev sea during last two decades but all of them concerned only summer time, but never winter. Compared with the data of those expeditions, our data do not seem really valuable but since they are the first winter data, we nevertheless represent them in our poster.

Bottom biotic communities are defined by low species diversity. We determined that dominating groups of the shelf of Laptev Sea are bivalve mollusca (due to biomass) and oligochaetas (due to biomass and abundance).

RECENT LAPTEV SEA WARMING IN CONTEXT OF OCEANIC HEAT ADVECTION TO THE ARCTIC IN THE LAST 2000 YEARS

R.F. Spielhagen¹, I. Dmitrenko²

¹Mainz Academy of Sciences, Humanities and Literature, Mainz, Germany

²Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

The Arctic is responding more rapidly to global warming than most other areas on our planet, indicated by rising air temperatures and a decline of the sea ice cover. As part of the meridional overturning circulation (MOC) which connects all ocean basins and controls global climate, northward flowing Atlantic Water is the major means of heat and salt advection towards the Arctic and strongly affects the sea ice distribution. Records of its natural variability are critical for the understanding of feedback mechanisms and the future of the Arctic climate system, but continuous historical records reach back only ca. 150 years. We present the first decadal scale record of temperature variations in the Fram Strait Branch of the Atlantic Current during the last 2000 years, derived from marine sediments off Western Svalbard (79°N). We find that prior to the beginning of atmospheric CO₂ rise at ca. 1850 A.D. average summer temperatures in the upper Atlantic Water entering the Arctic were in the range of 3–4.5°C. Within the 20th century, however, temperatures rose by ca. 2°C and eventually reached the modern level of ca. 6°C. Such values are unprecedented in the 2000 years before and presumably linked to the Arctic Amplification of global warming.

LAST INTERGLACIAL MARINE ENVIRONMENTS OF THE NORTHERN WHITE SEA REGION (BYCHYE SECTION) INFERRED FROM FOSSIL FORAMINIFERS AND OSTRACODS

E. Taldenkova¹, Ya. Ovsepyan¹, A. Stepanova², H.A. Bauch³, A. Strezh²

¹Moscow State University, Moscow, Russia

²Paleontological Institute RAS, Moscow, Russia

³Mainz Academy for Sciences, Humanities and Literature, Mainz, Germany

In relation to the overall importance of detailed reconstructions of interglacial marine environments and water circulation pattern in subpolar and polar northern regions, we carry out investigations of the past environmental changes and Atlantic-derived water inflows to the northern White Sea region during the Eemian transgression. The 4.5 m thick marine sediment sequence directly overlying the Saalian till in the Bychye section (Pyoza River, NE White Sea coast) was sampled for lithological and microfossil assemblage studies with 5 cm intervals allowing for obtaining a new detailed record of past events.

The first results on lithological characteristics and species composition of foraminifers and ostracods give an idea about the main trend of environmental changes during the existence of late Saalian/early Eemian marine basin in the studied territory. The early stage of inundation corresponding to accumulation of marine clays overlying the Saalian moraine stands out as a period of harsh fluvially-affected environment with cold turbid waters and heavy seasonal sea-ice cover. Further warming corresponding to accumulation of clayey silts and silty sands of the middle part of the section is evidenced by the growing total abundance and diversity of microfossils and high percentage of benthic foraminifers characteristic of the high seasonal productivity zone (*Islandiella* spp., *Nonion labradoricum*). The final regressive stage corresponds to accumulation of sands with gradually decreasing taxonomic diversity and abundance of microfossils and growing proportion of shallow-water species. So far, no direct indicators of the penetration of Atlantic waters in composition of microfossils (benthic foraminifer *Cassidulina neoteretis* or planktic foraminifers) have been found in the studied

sediment sequence.

SEASONAL AND MULTI-YEAR VARIABILITY OF THE SEA ICE CHARACTERISTICS IN THE LAPTEV SEA

A. Timofeeva

Arctic and Antarctic Research Institute, St. Petersburg, Russia

Sea ice regime of the Laptev Sea generally is characterized by strong variability. Ice extent anomaly ice massifs area anomaly during summer season for 2000-2008 were calculated in comparison with a norm. In general, frequency of negative anomalies during investigated period was higher than positive in both parts of the Sea and in both ice massifs. Values of negative anomalies were bigger than positive, exclude some values for Taymyrskiy ice massif area. Stable ice formation starts on the north and spread toward the south in the beginning of September. Data obtained on polar stations Tiksi and Kotelny for period 1935-2006 were analyzed. Dates of stable ice formation were correlated with air temperature of summer and autumn months. Correlation coefficient is significant for nearest months to the dates of ice formation: September and October. Statistically significant correlation between date of stable ice formation and minimal ice extent in September is not revealed for both stations. Multiyear linear trend of the variability of stable ice formation date has no distinct direction. Statistically significant relation was revealed for annual ice thickness maximum observed on the polar station Tiksi for period 1939-2006 and annual sum of freezing degree days.

LAPTEV SEA SYSTEM RESPONSE TO THE ARCTIC CLIMATE EXTREME EVENTS

L.A. Timokhov¹, H. Kassens², D. Bolshiyarov¹, J.A. Hoelemann³, I.A. Dmitrenko², S.A. Kirillov¹, A. Novikhin¹

¹Arctic and Antarctic Research Institute, St. Petersburg, Russia

²Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

³Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

We report on the Arctic climate change over the last decades with a main focus on the last three years. The anomalies of the Arctic Ocean surface layer and the intermediate Atlantic water layer temperature and salinity were compared with those for the Laptev Sea surface and bottom layer. For the Laptev Sea thermohaline structure the warmer period of 2000s is analyzed in respect to the cooler period of the 1970s. We discuss the response of both terrestrial and marine environment of the Laptev Sea system to the extreme changes occurred in this region over the last several years.

CROSS-VALIDATION OF POLYNYA MONITORING METHODS FROM MULTI-SENSOR SATELLITE AND AIRBORNE DATA: A CASE STUDY FROM THE LAPTEV SEA

S. Willmes¹, T. Krumpen², S. Adams¹, L. Rabenstein¹, C. Haas², J.A. Hoelemann², S. Hendricks², G. Heinemann¹

¹Trier University, Trier, Germany

²Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

A long-term monitoring and characterization of these polynyas requires stable methods to detect the area of open water as well as growth, thickness and evolution of thin ice. We examine different parameters and methods to observe polynya area and thin ice thickness during a prominent polynya event in the Laptev Sea in April 2008. These are derived from visible, infrared and microwave satellite data. Airborne electromagnetic ice thickness measurements with high spatial resolution and aerial photography taken across the polynya are used to assess the feasibility of the used methods for long-term and large-scale polynya monitoring within this area. Our results indicate that in the narrow flaw polynyas of the Laptev Sea the coarse resolution of commonly used microwave channel combinations provokes sources of error through mixed signals at the fast and pack ice edges

SPATIOTEMPORAL VARIABILITY OF SEA-ICE COVERAGE, POLYNIA DYNAMICS AND ICE PRODUCTION IN THE LAPTEV SEA BETWEEN 1979 AND 2008

S. Willmes, S. Adams, D. Schroeder, G. Heinemann

Trier University, Trier, Germany

Polynyas in the Laptev Sea are examined with respect to recurrence and inter-annual wintertime ice production. We use a polynya classification method to derive daily polynya area from long-term sea-ice concentration data. This provides insight into the spatial and temporal variability of open water and thin ice regions on the Laptev Sea shelf. Using an empirical thin ice distribution within the thickness range from 0 to 20 cm, we calculate daily average heat loss and the resulting wintertime ice formation within the Laptev Sea polynyas between 1979 and 2008. Results indicate that previous studies significantly overestimate the contribution of polynyas to the ice production in the Laptev Sea. Average wintertime ice production in polynyas amounts to $55.2 \pm 25 \text{ km}^3$ and is mostly determined by the polynya area, wind speed and associated large-scale circulation patterns. No trend in ice production could be detected in the period from 1979 to 2008.